Investigation of Noise Pollution Levels of Four Selected Sawmill Factories in Delta State, Nigeria

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Abstract

A survey on noise pollution levels in four selected sawmill factories in Delta State has been conducted. The investigations involve physical measurement of the noise pollution levels using a BK precision digital sound level meter model IEC 651 type and a social survey, using questionnaire. The physical measurement assessed the different machines noise level in the factories and the background noise levels measured at 50 meters away from the factories. A mean level of machine noise pollution (and background noise level) of 103.77±4.71dBA (78.25dBA), 96.55± 1.48(72.08), 99.02±3.20 (72.54), 99.97±3.66 (79.89) dBA was recorded in Ozoro, Ughelli, Warri and Sapele respectively. These values obtained show that the noise levels in the four factories investigated are well above the FEPA recommended maximum permissible limits for an industrial environment. This may cause hearing impairment and some psychological effect like susceptibility to mistake, irritation, and sleeping and social discomfort among staff and resident living in close to these factories. This is further affirmed by the social survey result which revealed the level of social discomfort and health menace caused by machines noise from the factories on the workers and those residing close to these factories. Recommendations were therefore made to control, and abate this health threatening pollution effects.

Keywords

Survey; Noise Pollution; Sawmill Factory Delta State

Introduction

The greatest challenge confronting industrial noise regulatory effects in states and nations today is how to reconcile environmental noise improvement (reduction) with economic growth due to the fact that the quest for industrialization and economic emancipation has made many developing countries in the world to embrace urbanization through industrialization without proper assessment and investigative measures of the environmental noise pollution impacts.

Noise can be broadly classified into industrial and domestic type (Jackson, 1990). Industrial noise is derived from industrial equipment sources, such as heavy duty machines, generators, aircrafts, sawing machines, pumps and fans blades etc whereas examples of domestic noise which are derived from municipal and domestic source include road traffic system grinders, vehicular Sirens, musical system noise e.t.c (Owate, et.al 2005). Industrial noise pollution herein may be any undesired sound originating from industrial machines or equipment that causes menace to man and its environment. Industrial noise can impact company personnel and the ecosystem of the host environment by its numerous psychological effects; while noise can startle, annoy and disrupt concentration, sleep and relaxation, interference with speech communication as a consequence interference with job performance and safety as well as physiological effect such as noise-induced lost of hearing or aural pains (Avwiri and Nte, 2003)

The hazardous nature of industrial noise necessitated the formulation of industrial permissible noise exposed limits for Nigeria by the federal environmental protection agency (FEPA) to which an employee may be subjected (FEPA, 1991). The FEPA guideline on industrial noise is shown in table 1.

TABLE 1 NOISE EXPOSURE LIMITS FOR NIGERIA (FEPA, 1991)

Duration per day (Hours)	Permissible exposure Limits(dBA)
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

Noise survey work has been carried out in some

industrial environment in the country. Menkiti, 1994, to study the noise level in an oil drilling environment and it was reported that both the levels and durations were grossly exceeded everywhere in the rig environment. Ebeniro and Abumere, (1999) measured the noise level in an industrial plant area of an oil servicing company involved in pipeline coating and production. The report revealed a noise deviation from the FEPA standard especially in the mechanic, coating yard and sand blasting area.

Ify and Owate, 2000, studied the noise pollution level of the Port Harcourt refinery and reported that of the 10 group of industrial equipment noise studied, 70% were high, 20% moderate and 10% low.

Avwiri and Nte, 2003, surveyed the environmental sound quality of some selected flow stations in the Niger Delta and reported that the noise levels status of the flow stations were within the FEPA recommended permissible limits and it was concluded that these values obtained may be not induce any hearing loss or aural pain and other psychological effects on the company personnel. On the environmental noise assessment on kobo-creek gas turbine in Bayelsa State, Avwiri et al., 2007, reported that the mean noise levels of the gas turbine was within the FEPA recommended range and may not constitute any serious health problem.

Although many individuals are not annoyed and claim to be undisturbed by noise, there are other effects of which they may be unaware. First, noise may be a factor contributing to the strain of civilized life which is attributed to various physical and mental ailments.

Secondly, exposure to noise exceeding 85 dBA has proved to cause hearing less temporarily and even sometimes permanently. Thirdly, noise of 90 dBA or above has been proven in the industry and in the laboratory to reduce working efficiency and increase the liability to make mistakes and thus resulting in decrease in productivity through increment in loss of man-hours (Ebemiro and Abumere (1999). This research work is therefore aimed at assessing the noise level of the sawmill machine to ascertain if they are within human tolerable limit. The inadequate research data on noise level specifically targeted sawmill industry in Delta State sawmill environment is lacking. More so, the gap in social survey to scientific analysis of noise pollution level and the socio- economic impact make this research work unique and relevant. It is on this premise that this noise survey work was carried out on some sawmill factories in order to assess and quantify the noise levels encountered in the day-day operation of these workshop tools within and outside the mills. The result of the study will enable us to ascertain the noise levels the employees are exposed to and the health implication of these noise levels. It will also give us a background on the type of precautions the company is to take to protect the host environment and increase their productivity.

Methodology

This study was conducted between August and September 2007, in some selected sawmill factories in Ughelli Sapela, Ozoro and Warri with focus on noise from the Sawmill workshop tools (machines).

The study comprised physical transient noise level measurement and social survey involving interviews and the use of questionnaires.

Transient Noise Level Measurement

Prior to this study, there was no record of any previous noise pollution studies of these sawmills in these areas, thus a preliminary field survey became necessary. The preliminary survey involve sites visit, initiation of noise measurement modalities and interaction/interview of officers and workers in the factories and those living in the neighbourhood of the factors.

The noise levels were measured *insitu* on the different workshop tools (machine) at a distance of 3 metres from the sources, using a Bruel and Kjaar (B&K) precision digital sound level meter (IEF 651 TYPE II) set on the A-weighting scale and slow response. Measurements were taken when the machine was put on (machine noise) and when wood was sawed (operational noise) and then the nature of the wood sawed was noted. The sound meter measured directly the *"Equivalent continuous sound level (leg) "as* digital numerical read out, which stabilized after about five minutes. During measurement, the meter microphone was directed towards the noise sources and the meter held away from the body. Five readings were taken at each spot when the machine was in operation and the average value recorded. This has been repeated for the different machine in the factory and the background noise level obtained when the different machines in the factory were in operation at an average distance of 50 metres from factory and the adjoining residential houses walls, which is a contribution to both the sound reflection from the wall and the floor of the buildings.

The noise pollution level Lnp has been computed using the expression (Owate, et al., 2005);

$$Lnp = leq + K\sigma$$

Where **K** is a constant with a value of 2.565 for this kind of environment and **σ** is the standard deviation of the obtained leq values (Avwiri and Nte, 2003).

Social Survey

Questionnaire was administered to 15 staff and 10 non-staff in each of the factory locations; whose day-to-day duties in the factory and proximity to the factories exposed to different levels of noise. A sample copy of the questionnaire was provided in the appendix for purpose of references. About thirteen questions were established and tailored in four areas of need as follows:

I) job identification as per noise exposure at the factory, his/her age bracket and average working hours per day
II) Staff noise sensitivity rate and conditions
III) Non-staff perceptions and views on the presence of the factory in that locations

A total of 94 out of 100 questionnaires administered were completed and returned, which formed the basis of the questionnaire response analysis presented in the results and discussion section.

Results and Discussion

Physical Measurements

Tables 1-4 represent the measured leq noise levels and the computed Lnp levels for Ozoror, Ughelli, Warri and Sapele factories respectively, while table 5 is the background noise level.

TABLE 2 OZORO FACTORY NOISE LEVELS (DBA)

		WORKSHOP WOOD	**WORKSHOP TOOLS NOISE LEVEL (DBA)**				
S/N	Workshop tools	Wood Sawed	Machine noise	Operational Noise	Leq. Level	Av. Lnp Level	Noise Rating
1	Machine Circular saving machine	Hard	89.1	101.5	91.55	107.38	V. High
2	Circular saving machine	Hard	82.6	100.5	82.65	103.63	V. High
3	Wood curving machine	Soft	80.1	85.2	95.05	94.73	V. High
4	Planning machine	Soft	91.6	101.7	93.90	107.13	v. high
5	Circular saving	Hard	86.1			105.98	V. High
		MEAN				**103.77±4. 71**	**V. High**

TABLE 3 UGHELLI FACTORY NOISE LEVEL (DBA)

		WORKSHOP WOOD	**WORKSHOP TOOLS**		**NOISE LEVEL (DBA)**		
S/N	Workshop tool machine	Wood Sawed	Machine noise	Operational Noise	Leq. Level	Av. Lnp Level	Noise Rating
1		Soft	90.3	94.1	91.55	107.38	High
2		Soft	92.1	95.4	82.65	103.63	High
3		Soft	90.2	98.2	95.05	94.73	High
4		Hard	86.	94.2	93.90	107.13	High
5		Hard	86.4	100.6	93.50	97.30	High
			MEAN			**96.55±1.48**	**High**

TABLE 4 WARRI FACTORY NOISE LEVEL (DBA)

		WORKSHOP WOOD	**WORKSHOP TOOLS**		**NOISE LEVEL (DBA)**		
S/N	MACHINE	Wood Sawed	Machine noise	Operational Noise	Leq. Level	Av. Lnp Level	Noise Rating
1	Circular saving machine	Soft	79.6	94.6	87.10	95.31	High
2	Circular saving machine	Soft	85.4	101.3	93.35	101.56	V. High
3	Planning machine	Soft	77.7	98.6	88.15	96.35	High
4	Wilson planning machine	Hard	80.7	99.6	89.85	98.06	High
5	Circular saving machine	Hard	90.1	101.1	95.60	103.81	High
			MEAN			**99.02 ±3.20**	**V. High**

TABLE 5 SAPELE FACTORY NOISE LEVEL (DBA)

		WORKSHOP WOOD	WORKSHOP TOOLS NOISE LEVEL (DBA)				
S/N	Work tool MACHINE	Wood Sawed	Machine noise	Operational Noise	Leq. Level	Av. Lnp Level	Noise Rating
1	Wilson planning & shooting machine	Hard	94.2	102.4	98.30	107.69	V. High
2	Bulgeria sawing, shooting & mortising machine	Hard	88.7	105.4	97.05	10.44	V. High
3	Metal sharpening machine	Metal	70.9	90.0	80.45	89.84	Moderate
4	planning machine	Hard	81.8	99.6	90.70	100.09	V. High
5	Circular sawing machine	Soft	76.8	96.0	86.40	95.79	High
		MEAN				**99.97 ± 3.20**	

TABLE 6 ENVIRONMENT BACKGROUND NOISE LEVEL (DBA)

S/N	LOCATION	BACKGROUND	NOISE LEVEL (DBA)	
		AV. Leg	Av. Lnp	Noise Rating
1	Ozoro	76.2	78.25	Moderate
2	Ughelli	69.0	72.08	Moderate
3	Warri	70.8	72.54	Moderate
4	Sapele	74.5	79.8	Moderate

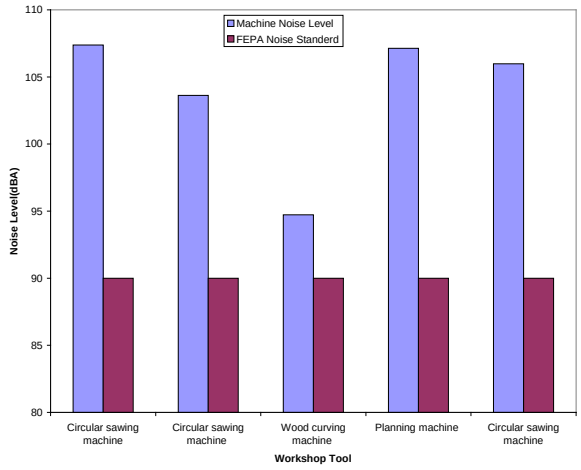

FIG 1 COMPARISON OF THE NOISE POLLUTION LEVEL IN OZORO FACTORY WITH FEPA STANDARD

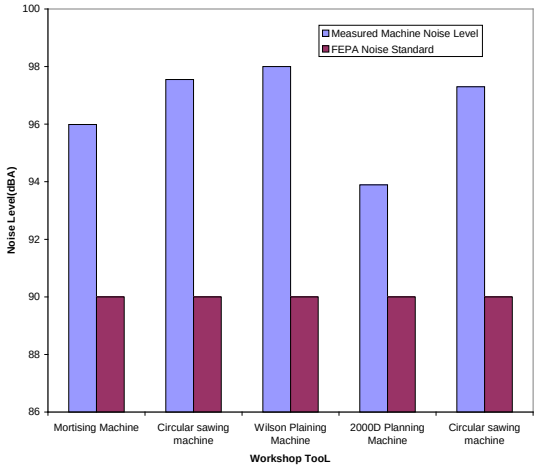

FIG 2 COMPARISON OF THE NOISE POLLUTION LEVEL IN UGHELLI FACTORY WITH FEPA STANDARD

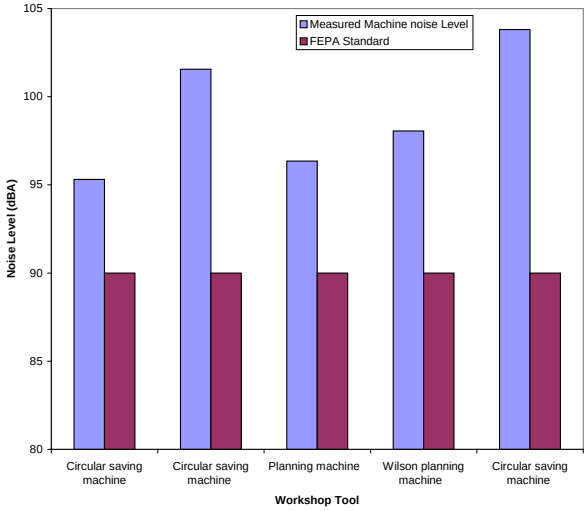

FIG 3 COMPARISON OF THE NOISE POLLUTION LEVEL IN WARRI FACTORY WITH FEPA STANDARD

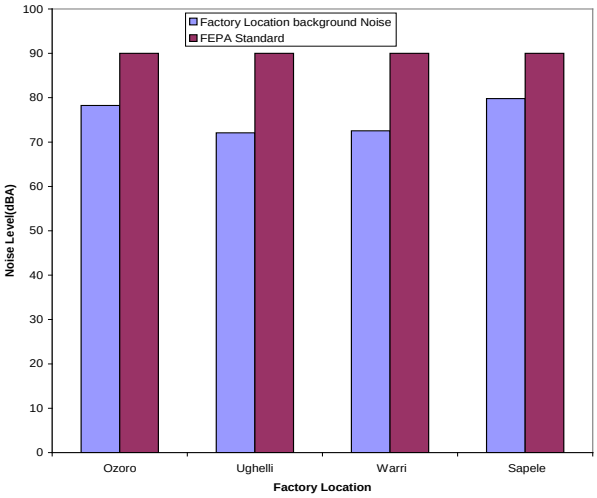

FIG 4 COMPARISON OF THE NOISE POLLUTION LEVEL IN SAPELE FACTORY WITH FEPA STANDARD

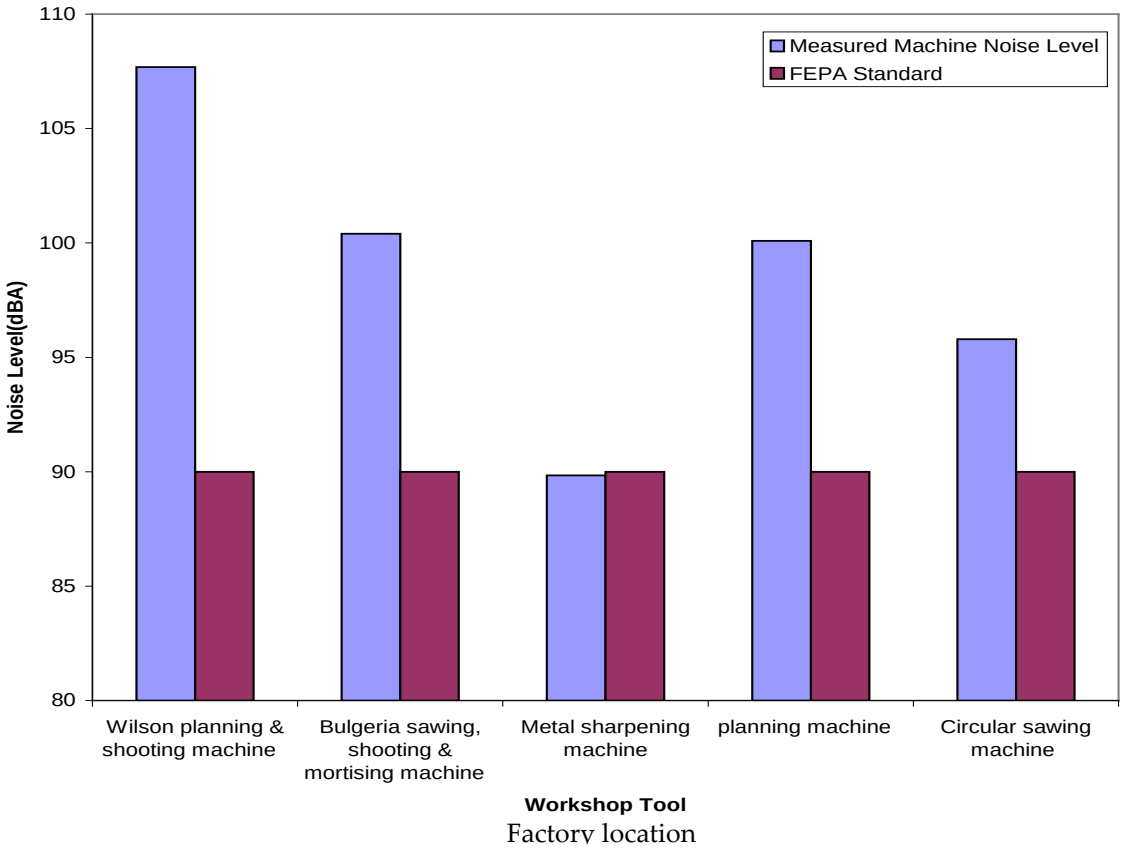

FIG 5 COMPARISON OF FACTORY LOCATION BACKGROUND NOISE LEVEL WITH FEPA STANDARD

Table 2 shows the values obtained in Ozoro Sawmill factory. The noise pollution level of the machines ranges from 94.73 to 107.38 dB(A) with a mean noise level of 103.77 ± 4.71dB(A) and background noise level of 78.25 dB(A). This value shows that of the 5 machines or workshop tools examined, 80% are above 100dB(A) (rated" very High') while only 20% as "High" (between 91–100 dB(A).

Table 3 shows the values obtained in Ughelli Sawmill factory. The noise pollution level of the workshop tools ranges from 93.89 to 98.00 d(B(A) with a mean machines noise levels of 96.55± 1.4dB(A) and background noise level of 72.08dBA. These show that all the machines surveyed noise are 'high'

Table 4 shows the values obtained in Warri Sawmill factory. The results revealed noise pollution value with the range from 95.31 to 103.81 dB(A) with a mean machines noise pollution level of 99.02 ± 3.20 d(B(A) and background noise level of 72.54 dB(A). This shows that of the five workshop tools (Machines) examined, 40% are rated "very high" and 60% as "High" while none falls in the range of moderate noise.

Table 5 shows the values obtained in Sapele Sawmill factory. The machines noise pollution values range is between 89.84 and 107.69 dB(A) with a mean noise level 99.97± 3.66 dB(A). The result shows that of the five workshop tools examined, 60% are rated "Very High", 20% as "High" while 20% as 'Moderate" (<90dBA).

Table 6 shows the environment background noise level measured at 50 meters away from the factories while figures 1-5 show the comparison of the Sawmill machines noise pollution level with FEPA recommended standard for 8 hours work per day.

The analysis of the general results indicates that the nature of the wood sawed contributed to the output noise level. This is evident when hard and soft woods are sawed, with hard woods generating greater noise. The obtained values show that circular sawing machines have the highest machine noise, followed by the planning and shooting machines, while the metal sharpening machine generates the least noise. However, observations revealed that age of the machines is a major factor to the level of noise generated or emanated from the machine. A comparison of the machine noise and operational noise shows a mean noise level difference of 13.84 dBA, 12.79 dBA and 8.53 dBA for circular sawing machines, planning and shooting machine and curving/mortising machines respectively. The overall result of the

measured noise pollution level revealed that the factories machine noise level in the four locations is far above the FEPA recommended maximum permissible limit for an industrial environment. Therefore, this noise levels may cause hearing loss to employees of these Sawmills especially the machine operators, and Some Psychological effect on the people living in these factories vicinities. This was observed during the oral interviews conducted within the staff of the factories.

Questionnaire Response Analysis

Questionnaire response analysis was performed using the completed and returned questionnaire on noise effects, structured to meet the four areas of needs as previously identified in subsection 2.2. The first area of need examined the issue of age bracket and the average working hours per day. Among many effects of noise pollution is that of accelerated presbycousis process (Impairment of hearing acuity with age). Presbycousis appears from the age of 30 years onward and becomes noticeable after the age of 40 years (Ify and Owate, 2000). For the studied factory sites, the age distribution when respondents joined the services of the Sawmills is as follow: under 25 years is 31.8% of the total respondents, 25 – 30 years 50.3%, 31 – 35 years 12.6%, and 36 years and above 5.3% respectively.

Apparently, about 82.1% of the Sawmills workers were 30 years or less and thus, the effects of accelerated presbycousis process on workers could be easily appreciated. Average time spent in the Sawmill factory on a typical working day is grouped as follows. 6 to 8 hours for 46.2 % of the total respondents while the remaining 53.8% spend more than 8 hours per day with no shift. Thus, the majority of the Sawmill workers may be at the risk of over exposure to high noise levels.

The second area of need reviews the workers noise sensitivity rate, safety conditions and hearing status. On the use of hearing protecting device, 78% respondents say "No" while only 22% uses earmuff. On the degree of convenience in putting on the hearing protective device by those that respondent yes, 62.3% says manageable while the remaining 37.7% say it is very inconvenient. In considering the noise from the machines total responses are as follows: 51% as convenient, 27.6% as noisy while 21.4% respondents say it is extremely noisy. Responds ton the auditory status of the employees in the four factories show that none of the workers have done auditory check up as many comment they never heard of such checkup previously. The result here shows that the level of hearing loss by the workers is on increase yet they are ignorant of this reality.

The third area of need is the neighbouring residents (Non-workers) noise sensitivity rate and tolerance level. Concerning their feelings about the noise level generated by these factories, 12.6% respondents says it is manageable, 40.8% responses as annoying, 38.2% as very annoying, 9.4% extremely annoying while no respondent says it is quiet. 63.2% respondents says the noise level at home (indoor) is very disturbing, 32.4% says it is less disturbing while 4.4% are indifferent about the degree of the noise experienced at home. This result shows that residents in the vicinities of these factories are disturbed by the level of noise generated and emanated from the machines.

The last two questions in the questionnaire were directed to investigate the perception and views of the residents (Host) in the areas about factory location impact and their mitigation measures, regarding the impact of the factories in the locations; and the following responses 49.2% claimed that is negative, 36% claimed it is positive while 14.8 was of equal positive and negative impact (indifferent). Next is the opinions of residents on the locations of the factories, 52% support relocation to non-resident areas, 30% supported that the factories should remain in the present locations, 18% recommended noise reduction technique approach to be adopted by the factories operators, while non support the re-establishment of more factories. The results indicates that the respondents was sensitive to the noise pollution from the factories while others considered the positive impacts on the overlooked polluting effects. However, the mitigation measure of noise reduction techniques is developed.

The overall questionnaire response results show that a large number of the respondents are sensitive to the noise pollution impact, especially the non-staff residing in the neighbourhood of the factories. Some respondents (mostly operator of machines in the factories) have already developed hearing difficulties of varying degrees. This is evident in the tolerance levels response by workers and non-staff of the factories. What was not clear is the respondents' pre-employment moving into these areas hearing conditions and the additional effects they have suffered on the account of the machines noise pollution within and outside the factories. This is an area where the heath control measures would serve useful purpose. The indifferent attitude toward the impact and location of the factories by some

respondents may be due to their trading activities, and stores within these areas which may be hampered by the relocation of the factories.

The investigation has led to the following recommendations that will help to control, and abate the ever increasing environmental noise from these Sawmills machines.

- All employee/workers of this Sawmills should be well protected against the high noise level generated by the machines in the factories.
- Increasing awareness and training programmes for staff and residents of the areas on noise safety and other pollution impacts should be carried out regularly.
- Employees should have a regular auditory checkup to know their hearing status.
- Sawmill factories should be sited in industrial or isolated areas to avoid the noise problem associated with mixed (domestic/industrial) environment
- Efforts should be made by factory owner/ operators to replace wear out machine parts and do away with obsolete machines which are the major contributors to the high noise level in these areas
- Regular noise auditing of the factories should be conducted to ascertain their compliance to FMEnv guidelines on noise generation.
- Government agencies responsible for the enforcement of laws or guidelines on noise should monitor Sawmills for compliance.

Conclusion

The need for noise pollution assessment in some Sawmill factories environment in Delta State has been demonstrated in this study. The physical measurement reveals that the noise level status in the four studied Sawmills are far above the FEPA recommended permissible limit for an industrial environment. Thus, the noise pollution level having impact on the sawmill workers could cause hearing impairment while the social survey revealed the level of social and health menace caused by the presence of these Sawmills to the employees and the people residing in these environments.

The analysis of both survey shows that the level of induced hearing loss and other psychological effects such as susceptibility to mistake, irritation, and sleeping and social discomfort on the factories personnel's is high. Thus recommendations have been made to control and abate these health threatening pollution effects.

ACKNOWLEDGEMENTS

The author wish to appreciate the total co-operation of the residents and factory personnel's of the four Sawmills for their positive responses to oral interviews, questionnaire administered and during the physical measurements.

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Appendix

Noise pollution questionnaire format

Staff Only

1) You joined the services of this factory between the ages of (i) under 25 years (ii) 25-30 years (iii) 31-35 years (v) 41 years and above

2) You have served in the factory as what? and for how long

3) Did you run a shift in the factory? (i) Yes (ii) No (iii) No answer

4) On the average, how many hours do you spend in the factory on a typical working day? (i) 6-8

hours (ii) above 8 hours

5) How do you consider the noise from your machines / workshop tools? (i) Quiet (ii) convenient (iii) Noisy (iv) extremely noisy

6) Do you use any hearing protecting device? (i) Yes (ii) No (iii) No answer

7) If yes to question 6, what is your degree of convenient in putting on the hearing protective device e.g ear muffs? (i) very convenient (ii) manageable (iii) very inconvenient

8) Do you go for auditory checkup (i) Yes (ii) No, If Yes how often

Non–Staff Only

9) How long have you being living in this place

10) How do you consider the noise generated by this factory machines? (i) Quiet (ii) manageable (iii) annoying (iv) very annoying (v) Extremely annoying

11) Your degree of noise tolerance at home (indoor) can be expressed as? (i) less disturbing (ii) very disturbing (iii) indifferent

12) The sitting of this factory in this area has brought? (i) Positive (ii) negative (iii) indifferent Impact.

13) On a general note, you will like that the factory (i) relocated (ii) remain (iii) noise reduced (iv) more established-or comment freely